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THE FIRST STAGE IN ARITHMETIC.

A Lecture given at the College of Preceptors, by the late REV. R. H. QUICK.

(Continued from page 17).

BUT at this proposal I know many experienced teachers would stand aghast. "What!" they would say, "turn one of the easiest lessons (easiest for the *teacher*) into one of the most difficult!" What can be easier than to say to a class: "Take out your slates and work the sums I write on the board?" Well, that is easy; but, when I was a lad, the master had a plan still easier. He gave us—or, rather, made our parents buy for us *from him*—a book with rules and examples. These examples we had to copy on our slates, and see if we could work them and get out the right answer. If we could do this in any way, however absurd, or with any expenditure of time, however great, the teacher had no trouble at all; but, if we did not get the right answer, we took our slates and joined a *queue* of boys that filed up to the teacher's desk. He looked at each slate in turn, examined the sum, and *did* it, and so proved to us that the book was right after all. This is the way in which I was *not* taught arithmetic! But even my old master had not attained to the easiest method of all of giving an arithmetic lesson. This method, however, has been discovered, and, I may say, brought to perfection, in a girls' school I once knew about, a school *not* belonging to the Girls' Public School Company. The teacher, like my old master, made every pupil get a book of sums with answers to them. So furnished, the pupils sat for an hour getting out as many answers like the book as they conveniently could with reference to their individual knowledge, skill, and industry. At the end of the hour, each pupil announced to the teacher the number of right answers she had obtained, and the number as given by the pupil was recorded without inspection in the teacher's book. If anybody happens to

know an easier method of "giving a lesson" in arithmetic, he will oblige me by mentioning it!

And here I come with my theoretical notions, and want to take away from the teacher the great practical advantage of having a very simple, straightforward occupation, or even of taking an after-dinner nap. *Vivâ voce* or vocal arithmetic with a class is a severe strain on the teacher—not the least doubt about it. The relaxations, well known to youth, whereby the tedious hours of school are beguiled of some of their tedium, are of various kinds, and, from the master's point of view, those with the pen or pencil are by far the least objectionable. Boys who are playing noughts-and-crosses are very quiet. A boy who is producing a likeness of the master invariably behaves in a most exemplary manner as long as the work of art is in progress. Even correspondence by notes passed from one part of the room to the other seldom obtrudes itself on the notice of the master, and, unless he can attend to two or three things at once, he is probably totally unconscious of it. So masters who wish to keep everybody quietly occupied mostly set something to be written. Take away from juvenile energy such unobtrusive outlets as I have mentioned, it is sure to find other outlets by no means unobtrusive. Pinching, *e.g.*, though not in itself a noisy operation, often occasions noise; and then follows inquiry, and the master has to estimate the value of conflicting statements; the order of the class is threatened, its time is obviously wasted. Even whispering among the boys makes it only too evident that the attention of the class is by no means concentrated on what is supposed to be the occupation of the hour. Hypocrisy has been called a tribute to virtue. In like manner the decorum of the schoolboy, though only skin-deep, is a tribute to the supremacy of the master. So long as everything is quiet, the master may fancy himself monarch of all he surveys; but, directly whispering begins, he feels that he is dethroned.

So, when the practical man points out the advantages of giving a form something to write, I am bound to say: Yes, my friend, I know these advantages of old, and have often jumped at them, though painfully conscious of the attendant *disadvantage*, that all my time out of school would go in correcting what had been written in school. This, however,

by the way. All I wish you to observe is, that I know it is a very difficult task to keep up the attention or even the discipline of a large class, if all the work is taken *vivâ voce*. But this difficulty may be got over by ordinary mortals when the subject of the hour admits of an infinite number of questions, easily found and easily answered, and where the pupils can be arranged for ready place-taking.

As for easy questions, there is no subject better than arithmetic. Inexperienced masters waste a vast amount of time by making their questions too hard. I do not mean to say that hard questions should never be asked. They have their uses at times; but the great mass of questions—99 per cent. of the questions—should be easy. This is true in most subjects, for the main duty of the teacher is to get the minds of his pupils to deal readily with the notions already stored; but it is most of all true in arithmetic, for the art of arithmetic consists chiefly in performing, accurately and readily, different series of operations, each operation in itself being of the simplest and easiest kind. If a difficult arithmetical problem is set before us, we may not know what to do, so we cannot get on at all; but, the instant we see what to do, the whole thing resolves itself into a series of small operations, each one of which we could have performed when we were ten years old. Thus we see that, with reference to the *art*, the main difference between the skilled arithmetician and the ordinary schoolboy is that the one can do readily and accurately what the other can do indeed, but only with effort and with frequent mistakes.

The young, then, must be trained to perform these simple operations quite accurately and quite easily. And to get this accuracy and care an immense amount of brisk practice is needed. The mind works by means of established sequences or trains, and these trains whether natural or conventional, are fixed by repetition. The mind goes easily along the accustomed path. If I were to ask you what letter came after L, you would have not the smallest effort to make in saying M; but suppose I ask what letter comes before L, probably many of you would not be able to answer without running along the sequence H, I, J, K, L. Now in arithmetic all our power depends on the perfect ease with which we run along certain short trains, and our children as a rule

fail because we do not practise them in these trains till effort is no longer needed.

We are to children what the professional gymnast is to the ordinary man. The gymnast performs what he considers a very simple and easy feat, explains how it is done, and calls on the untrained man to imitate him; but the untrained muscles cannot do it. At length by repeated efforts the pupil after a fashion succeeds; but his muscles are tired, and he cannot then and there do it again. The teacher must have patience. He must remember how many years he has been practising, and must not suppose that what is now so easy to him is easy for the beginner. No doubt everybody will readily assent and say, "Oh, yes, we know teaching requires a great deal of patience;" but I am convinced that only those who have tried to teach young children properly have anything like an adequate conception of the amount of patience required. In practice the gymnast is so apt to throw a somersault and then scold his pupils for not following him. I have been a schoolmaster most of my adult life, and I have been intimately associated with all kinds of schoolmasters. This has led me to form a very high estimate of their honesty, of their devotion to their work, and of their interest in their pupils; but, as a rule, they do not seem even to themselves very successful as teachers. You hear them almost universally grumble at the stupidity of their pupils. This, I own, proves to me the existence of stupidity somewhere. Is this stupidity shown in the construction of the mind of our average pupil, or in the way in which that mind is dealt with? Suppose we came across a music-master, say a teacher of the piano, who bemoaned the stupidity and clumsiness of his pupils; suppose he complained to us, "I don't know how it is, but it's very rarely indeed that I get a pupil to play the piano. They are always stumbling and bungling, and in spite of all my showing how, they never play right. And then they have no memories. They never know for certain what time they are playing in, and constantly take the lines in the bass for the lines in the treble." We should probably say in our minds, though we might be too polite, as we often are, to tell the truth: "My good sir, it is quite possible for a teacher to stumble and bungle as well as a pupil; and if you tell

me that almost all your pupils drive you crazy by their stumbling and bungling, I think I may tell you with some confidence that you don't understand your business. You should exercise them thoroughly in things they can play without stumbling; and, as they acquire power, you should employ this power on tasks of gradually increasing difficulty." Now we often hear loud complaints of the stumbling and bungling of our children in arithmetic. This raises at least a presumption that we don't know our business. Let us reckon the school-time of a child as going on 40 weeks in the year, and during those weeks for 5 days in the week. If the instruction of the child begins at 5 years old, and he is practised each of the 5 days for 10 minutes in arithmetic, this will give 33 hours in the first year. In the next year we will allow 15 minutes a day, and from that time 30 minutes a day. At this rate the child, on reaching the age of 10, would have practised arithmetic 380 hours. Now a good deal may be done in 380 hours, or even in 300. But as things go, much of this time will have been spent, not in establishing the necessary trains and practising the use of them, but in inventing and applying devices for doing without them. I have known a child attain to great accuracy, and (considering the method) remarkable speed in doing addition sums by counting taps with his slate pencil. Subtraction sums are often performed by making a number of marks on the slate, then rubbing out the number to be subtracted and counting the remainder. All this sort of thing must be entirely swept away. Those who are inclined to take my advice will abolish the slate altogether. Neatness and accuracy of column should be rigorously insisted on whenever notation is used, and all the work should be shown up; no scribbling figures and rubbing them out again, no scraps of paper that may be at once destroyed. But what I wish to insist on, over and over again, is *numeration before notation*; don't allow any written record of calculations till the short trains are established in the mind, and the power of writing down neat figures in good upright and transverse columns has been established in the hand.

There has been much discussion at what point the children begin to think of numbers as abstractions. The Germans, as we have seen, insist that numbers should be taught sensuously.

When this is done carefully, without haste, the power and habit of abstraction will come in due time; and when it has come the short trains must be established by daily *vivâ voce* practice carried on very smartly.

* As a preparation for written arithmetic the pupil should be practised in getting the numbers not by the ear, but by the eye. Such exercises do not belong strictly to the first stage; but, as I have spoken of *vivâ voce* arithmetic, I must draw attention to this form of it. What is generally called "mental arithmetic" is properly arithmetic in which the voice and ear are employed, as distinguished from that with the eye and hand. The *mind* may be said to take part more or less in every calculation. As a training, then, for written arithmetic the eye should be employed. Every pupil should be furnished with a paper or card on which the same set of figures should be written or printed. It will be a good practice to dictate the figures before the *vivâ voce* begins; then the boys will benefit by their own neatness or suffer by their want of it.

A set of figures such as these will give a good number of questions.

A	3	8	5
B	2	4	7
C	9	3	6
D	7	5	1
E	3	7	6
F	8	2	7
G	9	4	6
H	3	8	5
I	6	2	8
J	7	5	9

First, for addition the master may demand the sum of say D, or H, or F, the digits being added crosswise. Or he may say "A+C," "B+A," &c., &c. Or he may say, "The sum of three lines from F upwards, the sum of three lines from B downwards, &c." For subtraction he may direct the boys to add the left-hand and middle digit of the named line and subtract the right-hand digit from that sum, or to find the sum, say, of F and of G and subtract the less from the greater. Or a fixed subtrahend may be agreed upon, say 7, and the sum of any line or lines may be required—7. (The last exercise, by the way, has the drawback that a sharp boy will drop a 7 at first.) For multiplication it is very important that the eye should, as it were, by a glance at two numbers suggest the product. It is an excellent exercise to take three digits and add the third to the product of the first and second. If the master first requires the digits to be taken from left to right he can get ten questions by naming the letters; next he can have the digits taken from right to left and get ten more. He can then get almost any number of questions by having the digits taken upwards or downwards as he may direct; he then gives the digit to start with by naming it, as, say, "E left" or "E right" or "E middle." For division the left-hand digit may be taken as divisor, and the two right-hand digits with their topical value may be taken for dividend; or a fixed divisor may be taken and any pair of figures may be taken for dividend. The details may vary to any extent so long as the main object is kept in view, which is to give an immense amount of practice in the ordinary trains. The work if done as it should be, very smartly, is tiring, and 15 or 20 minutes (even less at first) will probably give enough of it.

The practice I said is tiring. Of course, the master is the trained gymnast and should not get tired as soon as the pupils. In teaching very young children I can get on well enough answering from my own head all the questions I ask; but directly my boys show any skill (and I have by such practices as I mentioned made some boys very skilful and ready with their trains), directly my boys get pretty sharp I prepare my own paper with answers in red ink, or I ask the questions from such a book as Henry Hopkins' *Teacher's Manual*. So fortified I face my class prepared for rapid place-taking. To the device (the purely English device, as far as I know) of place-taking I owe many pleasant hours of my life in the schoolroom, hours in which we none of us ever got drowsy. I must not linger on the topic, but in passing I cannot help saying that the ordinary method of place-taking is a very clumsy one, for it gives every advantage to the

*The paragraphs in small type were omitted in giving the lecture

cleverest boys and enables them to distance the rest without exertion. A better plan than this is to number up every 10 minutes and then give each boy not the number of his place, but 2 if he is up, 1 in his place, and 0 if he is down; *i.e.*, reckoning from his place when the class numbered up before. In this method, by the way, the top boy is always up and the bottom boy down. But a still better plan is to mark by the sum of two place-takings, and after recording the numbers of the first place-taking, start with the order reversed. After a brisk fire of questions this is the fairest method possible. Of course the question must always be asked, and sufficient pause allowed for the work, before the master names a boy to answer, and the question must then be passed as rapidly as can be.

Part of the *vivâ voce* lesson should be spent in securing accurate knowledge of the meaning of the words used in arithmetic. Incredible as some may think it, we often find boys who can do sums in G.C.F. or L.C.M., and yet don't know what a factor or a multiple is. Further, the boys should be exercised in analysing the numbers greater than 100 so as to recognise the prime numbers, or to resolve a number not prime into its prime factors. It will also be convenient to teach powers and indices very early.

As for the *science* of arithmetic, it must be taught very gradually. If numeration based on collections of tens is once thoroughly understood, and if every fresh operation is first of all made out *vivâ voce* with a number of examples dealing only with low numbers, the difficulties of the science will seldom be found insuperable and rules may be dispensed with. We are perhaps familiar with the questions, "Please, sir, what rule am I to do it by?" "Please, sir, where am I to put the decimal point?" I am sorry to say anything that may sound harsh, but if you want to know what I think, I must express a strong opinion that any pupil capable of asking these questions has been badly taught.

My lecture goes on the assumption that our failures in this subject are mostly owing to rotten foundations. I have, therefore, endeavoured to show how sound foundations may be laid. I have not time this evening to talk about the building that should be erected when the foundations are well laid and have had time to settle; and, although as teachers you are professors of patience, I am aware that I have put you to a severe test already. I will conclude, then, with a remark of very general application.

We may divide all conscientious teachers into two great classes: first, those whose attention is taken up mainly with what they themselves think and do, and second, those whose attention is taken up mainly with what is thought and done by their pupils. Perhaps, I shall make myself best understood by telling you of a specimen of the first class of whom I learnt, or at least tried to learn, when I was young. He was a man

of some distinction, and was most conscientious and painstaking. He had a thorough mastery of the subjects, and he was ready to give any amount of time to me. But unfortunately he was like the gymnast who should suppose that he was teaching when he performed his feats before his pupils. I witnessed a feat, performed no doubt slowly, and with every explanation. I tried to do it after him, but stuck. The gymnast engrossed by his own performances never watched mine, and when I announced that I could not get on, all he did was to perform the feat over again. He was a very good man, and I wish to speak of him kindly and with all respect, but a good teacher he was not. The second class of teachers, a class to which I hope everyone present belongs, takes pains like the others to get their own notions clear; but when they come to teach, their attention is concentrated on the minds of their pupils. They carefully watch every operation of those minds. Whatever the mental feat may be, they have analysed the necessary movements, and they see their pupils perform them in the right way and in the right order. The first movement may, perhaps, be got through indeed, but clumsily and with difficulty. The teacher observes this, and practises the pupil in such movements till the first step can be taken neatly and easily; he does the same with the following movements, watching the mind of the pupil throughout. To such a teacher the pupil's mistakes and misconceptions cease to be irritating. As Professor Meiklejohn has well said, the teacher's business is not simply to correct mistakes, but to trace them to their source; and the teacher should no more be vexed by a blunder than a doctor by a furred tongue. He should be interested by it, and by means of it should endeavour to diagnose the complaint.

What a vast subject is *teaching*, boundless as its own subject, which is the human mind! The treatment of the mind, one would think, should not be undertaken by the prentice hand any more than the treatment of the body; but a man has to go through a course of five years' training before he is thought competent to deal with our bodies, and from the teacher less preparation is required than even from H.M. Inspectors of Schools, for a Minister of Education has informed us that these have to be in training for "at least a fortnight." But, though we move slowly, teachers are by degrees getting to see that, whether they are required to learn it or not, there really is

something for them to learn. When their minds are in this receptive condition they may learn from very different people. A wise doctor will profit by what he hears from a professor lecturing on embryology and from an old woman who can cure warts. So, too, a wise teacher will listen to the results arrived at by the psychologist, and to the last tip that is suggested for collecting pens. Nothing will be too great or too small for his consideration. All theory concerns him if it is true, all practice if it is right. There is a sense in which the familiar words "While there is life there is hope" should come home to us all. So long as we are *alive*, i.e., so long as we have not become mere machines for performing certain teaching or other functions, so long there is *hope*. Hope shews the life of the mind, as breath shows the life of the body. The living teacher has hope, the hope of doing better; his great desire is to know the best that has been thought and done, his great object is to bring his own thought and practice nearer to it.

"TO YOU AND TO YOUR CHILDREN."

SOME THOUGHTS FOR YOUNG MOTHERS.

BY MRS. ASHLEY CARUS-WILSON (MARY L. G. PETRIE, B.A.)

"HISTORY is philosophy teaching by example," says an oft-quoted saying, attributed to Dionysius, of Halicarnassus. No history contains more inspiring examples of heroism than Holy Writ, and in all its gallery of heroes, three stand out pre-eminent as men whose dauntless courage was united with an absolute unselfishness and single-hearted devotion to the service of God, which meant that all their great work for men received no reward from men, and that their fame was, in Milton's noble words, "no plant that grows on mortal soil." Many had, indeed, cause to rejoice at the birth of all the three, and for the parents of all, as well as of him to whose parents that lot was directly predicted, there was the joy and gladness of bringing into the world one who left it better than he found it. They represent three very different ages, for *Jeremiah* was of the Old Covenant, *S. Paul* of the New Covenant, and *S. John the Baptist* fills a unique place between the two covenants of God with man.

But many parallels between their lives suggest themselves, ere we pass to consideration of that common feature in them which is of special significance to parents.

From the beautiful life of a God-fearing home, all were called to careers pathetic in their loneliness. "Thou shalt not take thee a wife," was God's command to one of the most affectionate of men (Jer. xvi. 2). Zacharias and Elisabeth, well stricken in years when their only child was born, can hardly have lived to see his manhood, and from early youth he became a hermit in the desert. S. Paul alludes directly to his solitary condition (1 Cor. vii. 7). In each we see deliberate renunciation of the family ties, which are always lawful and generally expedient, that they might give themselves wholly to the work of preaching repentance in an age of crisis and judgment, and for each of the three this personal solitude